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Single-Shell Tank Ventilation Upgrades Needs Analysis Report

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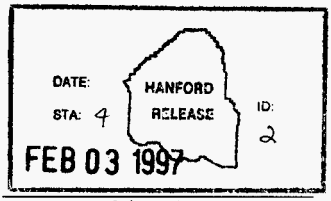
Abstract:

This report was written to comply with the objectives of the *Hanford Federal Facility Agreement and Consent Order, Tri-Party Agreement* Milestone M-43-03 "Provide to the Washington State Department of Ecology and Department of Health the Results of the Single-Shell Tank Ventilation Upgrades Needs Analysis". The needs analysis consists of identifying the current type and status of each single-shell tank ventilation system, identifying current and projected authorization basis requirements, and identifying ventilation system compliance deficiencies.



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SINGLE-SHELL TANK VENTILATION UPGRADES

NEEDS ANALYSIS REPORT

January 6, 1997

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EXECUTIVE SUMMARY

This report was written to comply with the objectives of the *Hanford Federal Facility Agreement and Consent Order* (DOE/RL 1994a), Tri-Party Agreement (TPA) Milestone M-43-03 "Provide to the Washington State Department of Ecology and Department of Health the Results of the Single-Shell Tank Ventilation Upgrades Needs Analysis" by providing the subject report. The needs analysis consists of identifying the current type and status of each single-shell tank (SST) ventilation system, identifying current and projected authorization basis requirements, and identifying ventilation system compliance deficiencies. Other requirements (i.e., environmental, design, testing, etc.) are identified and specifically addressed in *Tank Farm Restoration and Safe Operations Initial Assessment Report HVAC Systems* (WHC 1996k).

The U.S. Department of Energy (DOE) established the Tank Waste Remediation System (TWRS) program to manage and dispose of the waste contained in underground storage tanks at the Hanford Site. There are 177 underground waste storage tanks of which 149 are SSTs in 12 distinct tank farms. There are 28 double-shell tanks (DSTs). One hundred thirty-four of the SSTs have passive ventilation systems, while 15 are actively ventilated. Currently 115 of the SSTs have already had most of the liquid removed (WHC 1996i).

The current authorization basis documents identifying SST ventilation system requirements include the *Single-Shell Tank Interim Operational Safety Requirements* (WHC 1994a) (IOSR), the *West Tank Farms Standing Order* (FDH 1996a) (S/O), and the *East Tank Farms Standing Order* (FDH 1996b) (S/O). However, through an effort to enhance operational safety, TWRS is implementing the *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b) (BIO), *Tank Waste Remediation System Technical Safety Requirements* (WHC 1996c) (TSR) and *Tank Waste Remediation System Safety Structures, Systems, and Components: Requirements and Characteristics* (WHC 1996d) (SSC). These documents are being reviewed by the DOE for approval and will provide the authorization basis for operation until the Final Safety Analysis Report (FSAR) is released. Additionally, each SST's ventilation system will be evaluated according to the Interim Stabilization (IS) requirements that are defined in the *Controlled, Clean, and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e).

All SSTs are ventilated by either a passive or an active exhaust system to prevent over pressurization. The primary functions of the ventilation systems are two-fold: 1) mitigate the vapor space ignition risk by maintaining flammable gas levels less than the safety limit, and 2) remove radioactive decay heat to limit waste temperatures and preserve tank structural integrity. All ventilation systems include High Efficiency Particulate Air (HEPA) filters in the inlet and exhaust paths to eliminate the risk of releasing airborne particles. The passive systems rely on changes in atmospheric pressure to exchange the tank vapors with outside air. The active systems use an exhaust fan to pull vapors from the tank. Ambient air replaces the tank vapors through an inlet HEPA filter. This assures that vapors exiting the tank are properly filtered when the ventilation fan is not operating.

The current SST passive ventilation systems have been evaluated (WHC 1996a) and found to be satisfactory for controlling steady-state flammable gas. Active ventilation systems that are to be installed on tanks C-105 and C-106 in support of the W-320 Project are satisfactory. However, the ventilation system supporting tanks SX-101 through SX-112 and SX-114 have components that have exceeded their design life by at least 17 years. This system requires further evaluation to verify its functional capabilities to verify its capability to mitigate flammable gas concerns and

a risk assessment be performed on the SX-farm active ventilation system. All SST operations are required to comply with the *West/East Tank Farms S/O* (FDH 1996a, FDH 1996b) requirements for flammable gas controls. Table 1 provides a summary matrix of this needs analysis.

To support the IS function, control instrumentation upgrades with connections to the Tank Monitoring and Control System (TMACS) are required for SSTs that continue to require active ventilation. The passively ventilated systems will adequately support IS with minor changes which can be accomplished through continuing maintenance activities.

Ventilation requirements for other SST operations and activities such as waste sampling, stabilization, and retrieval will be evaluated on a case basis. It is expected that most of these activities will use individually engineered ventilation systems which have been designed specifically for the activity and will meet the requirements of the *West/East Tank Farms S/O* (FDH 1996a, FDH 1996b) or the current authorization basis.

A FSAR is currently being generated. The FSAR accident scenarios are similar to those calculated for the *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b), and there is no indication that the approved requirement set will change the SST ventilation criteria or require extensive upgrades. Following DOE Headquarters approval of the FSAR, it is recommended that SST ventilation systems be reviewed to ensure compliance with the FSAR.

The intended users of this report include Hanford Site Tank Farm personnel, DOE, the Washington State Departments of Ecology (Ecology) and Health (WDOH) and the public.

Table 1. SST Ventilation System Summary.

A Total of 149 SSTs	NUMBER
SSTs Passively Ventilated	134
SSTs Actively Ventilated	15*
Active Ventilation Systems	2 (C-farm, SX-farm)
NEEDS ANALYSIS CONCLUSIONS	**NUMBER**
Continue to maintain present status	134
SSTs Undergoing Ventilation System Modification	2 (C-farm under Project W-320)
Recommend Risk Assessment	13 (all in SX-farm; one system)
Modifications required to comply with Interim Stabilization (IS) requirements	13 (all in SX-farm; assuming the upgraded C-farm ventilation system meets IS requirements)

*Thirteen (13) tanks are connected through cascade lines to one ventilation system in SX-farm. Two (2) tanks are connected through a cascade line to one ventilation system in C-farm.

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ACRONYMS

BIO	Basis of Interim Operation
CAM	Continuous Air Monitor
CCS	Controlled, Clean, and Stable
DOE	Department of Energy
DST	Double-Shell Tank
Ecology	Washington State Department of Ecology
FSAR	Final Safety Analysis Report
GRE	Gas Release Event
HEPA	High Efficiency Particulate Air
IC	Ignition Controls
IOSR	Interim Operational Safety Requirements
IS	Interim Stabilization
ISSTRS	Initial Single-Shell Tank Retrieval Systems
JCO	Justification for Continued Operation
MTBF	Mean Time Between Failures
RMCS	Rotary Mode Core Sampling
ROM	Rough Order of Magnitude
S/O	Standing Order
SHMS	Standard Hydrogen Monitoring System
SSC	Structures, Systems and Components
SST	Single-Shell Tank
SWP	Salt Well Pumping
TMACS	Tank Monitoring and Control System
TPA	*Hanford Federal Facility Agreement and Consent Order* or Tri-Party Agreement
TWRS	Tank Waste Remediation System
TSR	Technical Safety Requirements
USQ	Unreviewed Safety Question
WDOH	Washington State Department of Health

1.0 PURPOSE

The purpose of this report is to provide a needs analysis of the single-shell tank (SST) ventilation systems and recommended actions to resolve requirement compliance issues. This report documents the SSTs current ventilation system status. Additionally, it evaluates the current and proposed future requirements that might dictate system upgrades. The status of all of the individual tanks are listed and recommended ventilation upgrades which may be needed to maintain safe storage of the tank waste are identified. The scope of the report includes the following tasks:

- Identify the authorization basis dictating SST ventilation system requirements [including projected future authorization basis requirements like the *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b), etc.];
- Determine the applicable SST ventilation criteria required to support the safe storage mission, Interim Stabilized (IS);
- Identify non-authorization basis documents such as Operational Specifications Documents (OSDs);
- Assess the current status of SST ventilation systems against the above criteria;
- Identify potential deficiencies of the current SST ventilation systems as identified by the evaluation of the above criteria;
- Identify the ventilation interface requirements for the retrieval function as required; and
- Recommend a preferred path forward where deficiencies are identified.

2.0 BACKGROUND

From 1943 to 1989, the Hanford Site's principal mission was the production of weapons-grade plutonium. The chemical separations processes used to extract plutonium generated several hundred thousand metric tons of high-level, transuranic, low-level, hazardous, and mixed waste. Through the early 1960's, this waste was stored in 149 underground SSTs.

The SSTs were designed with a life of approximately 20 years. Leakage of waste from the SSTs to the underlying soil was suspected in 1956 and confirmed in 1961. As a result of the leak, all SSTs were removed from active service with the transfer of waste to the tanks discontinued by November 1980. By the late 1980's, 67 of the SSTs were known or suspected leakers. To address concerns with the tank design, the Hanford Site adopted a double-shell tank (DST) design which provided for increased containment integrity and leak detection. Most of the free-standing liquid contained in the SSTs has been pumped into DSTs (a process called stabilization). However, the remaining solids still contain liquids within their void spaces. At the present time, 115 tanks have been stabilized as a result of most of the surface liquid being removed.

Two issues associated with the storage of the hazardous, radioactive process waste stored in underground storage tanks at the Hanford Site have been identified as follows: 1) increased heat loads, caused by radioactive decay resulting in waste temperatures, that could reduce structural integrity and result in structural failure; and 2) increased flammable gas levels, caused by radiolysis and decomposition of organic waste, located within the tank vapor space and other ex-tank intrusive areas that increase the risk of an explosion. Each SST has undergone extensive surveillance and characterization activities to identify individual risk factors and define the requirements for active or passive ventilation. Both ventilation systems provide evaporative cooling capabilities to mitigate high temperatures and air exchange capabilities to mitigate flammable gas concerns.

The *Hanford Federal Facility Agreement and Consent Order* (DOE/RL 1994a) was written to support the environmental cleanup of the DOE's Hanford Nuclear Reservation. It is composed of many milestones. Milestone M-43-03 "Provide to the Washington State Department of Ecology and Department of Health the Results of the Single-Shell Tank Ventilation Upgrades Needs Analysis" is the driving factor for this report.

3.0 EVALUATION PROCESS

As mentioned previously, the authorization basis is being modified to enhance safety. Figure 3.1 identifies the current top-level document hierarchy tree, while Figure 3.2 identifies the projected document hierarchy tree for the interim authorization basis. Table 3.1 provides a top-level summary matrix identifying the authorization basis documents that contain requirements relevant to SST ventilation systems. Note that other requirements (i.e., environmental, design, testing, etc.) are identified and specifically addressed in *Tank Farm Restoration and Safe Operations Initial Assessment Report HVAC Systems* (WHC 1996k).

Each SST was evaluated according to the logic flowchart shown in Figure 3.3. The detailed conclusions are listed in a SST compliance determination and status summary matrix in Appendix A.

The following criteria are identified for this evaluation of SST ventilation systems:

- Flammable Gas Concerns *[West / East Tank Farms Standing Orders* (FDH 1996a, FDH 1996b)(S/O)];
- High-Heat Load Requirements [*Single-Shell Tank Interim Operational Safety Requirements* (WHC 1994a) (IOSR)];
- Safety Structures, Systems, and Components identified from *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b) (BIO);
- Technical Safety Requirements [*Tank Waste Remediation System Technical Safety Requirements* (WHC 1996c) (TSR)];
- Interim Stabilization Requirements from *Controlled, Clean, and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e);
- *Operating Specifications for Single-Shell Waste Storage Tanks* (WHC 1996g); and
- *Operating Specifications for Watch List Tanks* (WHC 1996h)

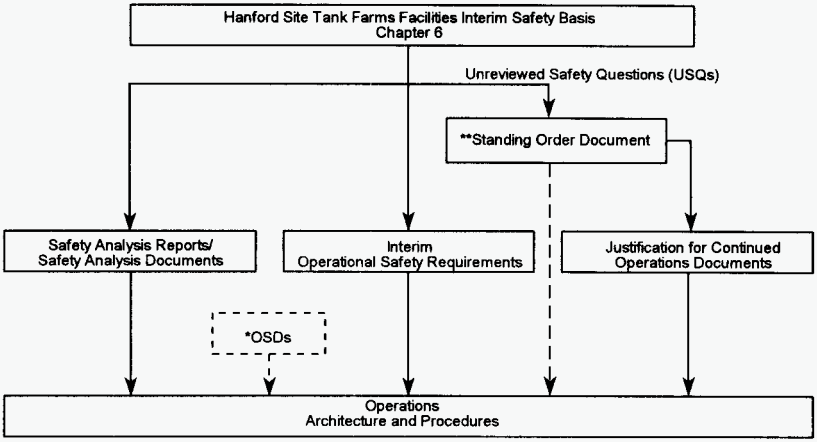
Additionally, the ventilation systems intended for use in SST retrieval activities will be identified.

Table 3.1 SST Ventilation System Authorization Basis Document Matrix.

	Authorization Bases Documents / Analysis Criteria								
	IOSR	S/O flammable gas controls	BIO SSC	BIO TSRs	IS	OSD-13	OSD-30	FSAR	FSAR TSRs
CURRENT (1996)									
Requirements	X	X			X				
Guidelines						X	X		
PROJECTED (1997 - FSAR)									
Interim Requirements			X	X	X				
Guidelines						?*	?*		
FUTURE									
Requirements					X			X	X
Guidelines						?*	?*		

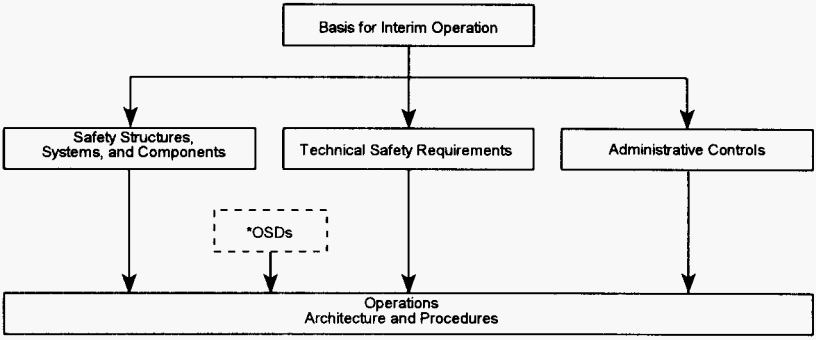
IOSR -- Single-Shell Tank Interim Operational Safety Requirements (WHC 1994a)
S/O -- West Tank Farms Standing Order / East Tank Farms Standing Order (FDH 1996a, FDH 996b)
BIO -- Basis for Interim Operation (WHC 1996b)
SSC -- Structures, Systems, and Components (WHC 1996d)
TSRs -- Technical Safety Requirements (WHC 1996c)
IS -- Interim Stabilized (WHC 1996e)
OSD-13 -- Operating Specifications for Single-Shell Waste Storage Tanks (WHC 1996g)
OSD-30 -- Operating Specifications for Watch List Tanks (WHC 1996h)
FSAR -- Final Safety Analysis Report
*The role that OSDs will have has not yet been determined for the interim authorization basis.

Figure 3.1. Current Authorization Basis Document Hierarchy



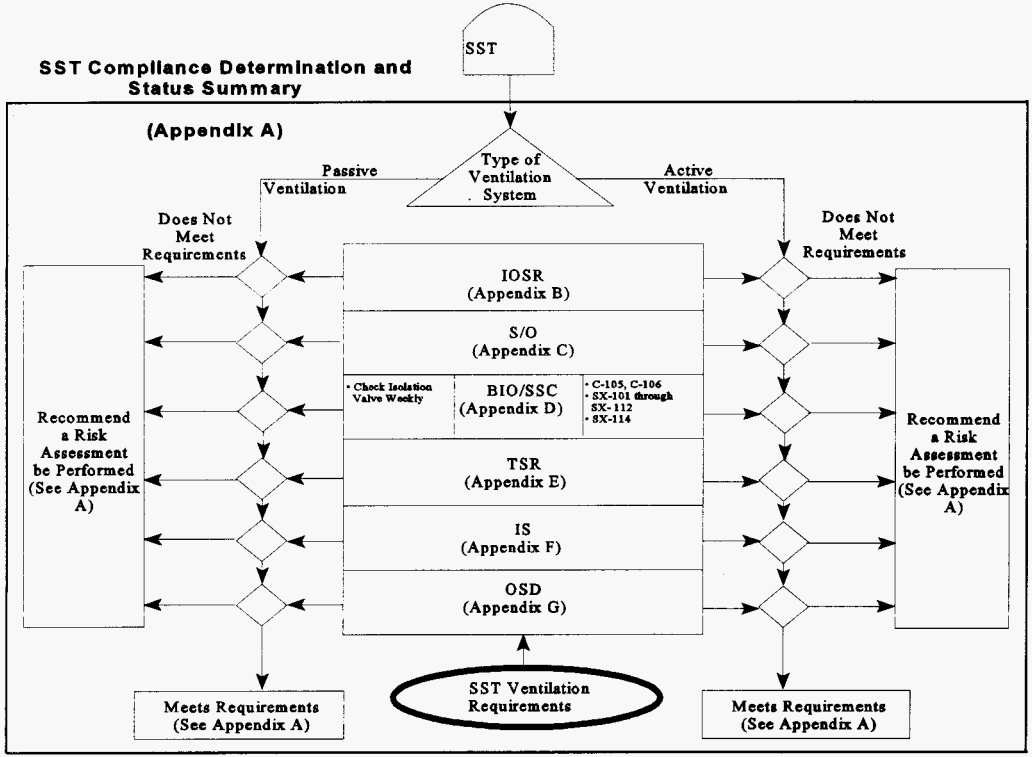
*OSDs -- Operational Specifications Documents provide operational guidelines.
**As Required for Continued Operation as a Result of a USQ Prior to Justification for Continued Operation Documents being Approved.

Figure 3.2. Projected Interim Authorization Bases Document Hierarchy



*OSDs – Operational Specifications Documents provide operational guidelines. The specific role of OSDs has yet to be determined in the Interim Authorization Basis.

Figure 3.3. Single-Shell Tank Ventilation System Needs Analysis Logic Flowchart



4.0 VENTILATION REQUIREMENTS AND EXISTING CONDITIONS

The current authorization basis identifying SST ventilation system requirements include the *Single-Shell Tank Interim Operational Safety Requirements* (WHC 1994a) and *West/East Tank Farms Standing Orders* (FDH 1996a, FDH 1996b). However, TWRS is implementing the *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b), *Tank Waste Remediation System Technical Safety Requirements* (WHC 1996c), and *Tank Waste Remediation System Safety Structures, Systems, and Components: Requirements and Characteristics* (WHC 1996d) as the interim authorization basis until the FSAR is released. Requirements for Interim Stabilization (IS) are defined in *Controlled, Clean, and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e). Additionally, operating specifications applicable to SST ventilation systems are identified in *Operating Specifications for Single-Shell Waste Storage Tanks* (WHC 1996g) and *Operating Specifications for Watch List Tanks* (WHC 1996h).

There are 149 SSTs located within 12 distinct tank farms. One hundred thirty-four (134) of the SSTs have passive ventilation systems, while 15 are actively ventilated. One hundred fifteen (115) SSTs have had most of the surface liquid removed from them and are classified as stabilized (WHC 1996i). Numerous tanks have been placed on a watch list because of flammable gas generation, evolution of organics, ferrocyanide problems, or evolution of heat above and beyond the set limit of 40,000 Btu/hr. Instrumentation such as thermocouples, waste level measurement instruments, etc. have been installed in each tank to allow physical condition monitoring. Additionally, Standard Hydrogen Monitoring System (SHMS) cabinets [some which are connected to the Tank Monitoring and Control System (TMACS)] have been installed on 21 SSTs to monitor the levels of hydrogen. Each tank is reassessed based on the latest surveillance information (measured flammable gas concentrations, increased temperatures, etc.). The latest SST technical data/status is reported in the monthly *Waste Tank Summary Report* (WHC 1996i). Watch list tank status is identified in *Operating Specifications for Watch List Tanks* (WHC 1996h).

Summarized descriptions of the following items are provided in this section and the requirements and status matrix in Appendix A:

- Ventilation system authorization basis requirements;
- Status of all SSTs from the latest available references;
- SST stabilization work; and
- Purpose and status of the ventilation system on each tank.

4.1 Ventilation Requirements

This section discusses the authorization basis safety requirements applicable to SST ventilation systems. For completeness, the actual requirements are provided in each of the appendices.

4.1.1 Interim Operational Safety Requirements (IOSRs)

The requirements identified in this document define the acceptable conditions, safe boundaries, bases thereof, and management or administrative controls required to ensure safe operation of the SST facilities. The scope of this document is based on the SST safety analysis reports (SARs) and other documentation. Requirements specific to SST ventilation systems include maintaining the waste temperature below 150 °C (300 °F) and maintaining required vapor space pressure per each actively ventilated SST, maintaining operable seal loops on each passively ventilated SST, and maintaining exhaust stack radiation monitoring systems on each actively ventilated SST. The specific requirements and limiting conditions of operation as well as the associated implementing document and/or configuration compliance statement are listed in Appendix B.

4.1.2 West/East Tank Farms Standing Orders (S/O)

The *West/East Tank Farms Standing Order* documents (FDH 1996a, FDH 1996b) provide the current authorization basis requirements for operating TWRS relative to flammable gas hazards. This document has been accepted by the TWRS Plant Review Committee and approved by the Department of Energy (DOE). The purpose of this document is to reevaluate and redefine the flammable gas Unreviewed Safety Question (USQ) (DOE/RL 1990) with respect to currently available data and methodology, clarify the applicability of the USQ to additional tanks and other engineered structures within TWRS, and consider additional flammable gas hazards not adequately addressed in the *Hanford Site Facilities Interim Safety Basis* (WHC 1995a).

Steady state gas releases are managed by diluting and removing the gases from the tank dome space through active or passive ventilation to prevent a steady accumulation of gas to flammable concentrations. Acceptable concentration levels are maintained as low as practical with the existing ventilation configuration. For tanks with a combination of small waste volumes, low-decay heat loads, small concentrations of organic chemicals, and relatively large dome spaces, steady-state gas releases can be maintained at low concentrations with passive ventilation.

Formal gas samples have been taken from approximately 42% of the SSTs as of July 1, 1996. An additional 31% of the SSTs have grab sample results. It is very important to note that the actual steady state gas concentrations measured to date are consistently below 25% of the LFL. Furthermore, these measurements have demonstrated that the measured values are significantly lower than the calculated values for passively ventilated tanks (WHC 1996a, WHC 1996f). Current ventilation procedures are adequate to mitigate flammable gas concerns and should be continued.

Flammable gas issues have been analyzed and all underground waste storage tanks have been evaluated and categorized in defined groups (facilities Group 1, Group 2, or Group 3) as a result of size and frequency of postulated gas release events. Two (2) sets of Ignition Controls (IC) have been established for operational activities for each group. These activities are described by 1) ex-tank intrusive; 2) dome intrusive; and 3) waste intrusive. Forty-four (44) SSTs are categorized in Group 2 with the remaining 105 categorized in Group 3.

Specially engineered ventilation systems are considered for some activities (see section 4.1.6) on a case basis and will incorporate the use of defined Ignition Control Sets as listed in Appendix C.

4.1.3 TWRS Safety Systems, Structures, and Components (SSCs): Requirements and Characteristics

The interim authorization basis for operation of TWRS facilities is provided in the *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b) (BIO). The BIO (WHC 1996a) will remain in effect until replaced by the new TWRS FSAR and its companion Technical Safety Requirements (TSR) document. The objective of the BIO (WHC 1996a) is to provide an improved interim authorization basis that will immediately enhance safe operation of the TWRS facilities and identify safety systems, structures, and components (SSCs). The SSC requirements and characteristics are documented in *TWRS Safety Structures, Systems, and Components: Requirements and Characteristics* (WHC 1996d). This document provides ventilation requirements for hardware deflagration controls which were developed to meet the ignition control set requirements established in the S/O (FDH 1996a, FDH 1996b) and specified in the BIO (WHC 1996b). It is possible that these requirements might change when the FSAR is approved; however, there is no indication that those tanks currently required to be on active ventilation systems will need upgrades to comply with the requirements. The requirements are listed in Appendix D.

4.1.4 TWRS Technical Safety Requirements (TSR)

The *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996a) identifies the operating restrictions and administrative controls that are necessary to preserve the validity of the safety analysis assumptions and to ensure that TWRS is operated within the required conditions bounded by the new analysis and are implemented through the *TWRS Technical Safety Requirements* (WHC 1996c). The TSRs define the acceptable conditions, safe boundaries, bases thereof, and management or administrative controls required to ensure safe operation during waste storage, transfer, and characterization. Requirements specific to SST ventilation systems include maintaining the ventilation radiation monitoring system on SSTs that are actively ventilated and maintaining active ventilation on the following tanks: C-105, C-106, SX-114, and SX-101 through SX-112. The specific requirements and the associated implementing document and/or configuration compliance statement are listed in Appendix E.

4.1.5 Interim Stabilization (IS) Functional Requirements

The TWRS has established the IS project for the SST Farms to reduce safety and environmental risks posed by the tank farms, and to reduce ongoing surveillance and maintenance costs for these same facilities. Interim stabilization ventilation requirements are provided in *Controlled, Clean, and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e). Ventilation system requirements ensure that radioactive gaseous/ particulate effluents are controlled in accordance with applicable laws. This is verified through the use of instruments that are remotely read through TMACS. Instruments specific to active ventilation systems include pressure sensing and radiation stack monitoring. The requirements are listed in Appendix F.

4.1.6 Operating Specifications Documents (OSDs)

Operating specifications are technical limits and controls imposed on a process or operation which, if violated, could jeopardize the safety of personnel and could damage equipment, facilities, the environment, and adversely affect product quality. These documents are not part of the authorization basis; however, the guidelines identified within these are important for consideration. Two OSDs identify specifications specific to SST ventilation systems: *Operating Specifications for Single-Shell Waste Storage Tanks* (WHC 1996g) and *Operating Specifications for Watch List Tanks* (WHC 1996h). Specifications identified in these two documents include, but are not limited to, maintaining waste temperature below 150 °C (300 °F), monitoring waste temperature on tanks with waste greater than 40,000 Btu/hr, monitoring vapor space pressure on each actively ventilated SST, maintaining operable seal loops on each passively ventilated SST, maintaining HEPA filters as required, and using spark-resistant tooling on flammable gas watch list tanks. Specifications from these two documents are listed in Appendix G.

4.1.7 Intrusive Operations

4.1.7.1 Rotary Mode Core Sampling (RMCS). The portable exhauster (ventilation system) to support the RMCS operations was designed in 1993. It was designed with 1) flexible ductwork for connection to a tank riser; 2) a heater to lower the relative humidity (which helps reduce condensation); 3) a pre-filter which removes larger particles and increases the life of the HEPA filters; 4) a fan; and 5) a stack to disperse the ventilation gas. The RMCS exhauster components are being modified to meet the flammable gas requirements as identified in the RMCS safety analysis document (WHC 1996l). Additionally, the exhauster components meet the interim authorization basis ignition control set requirements (WHC 1996c). Specific design parameters were followed to utilize a non-sparking fan blades/housing and nitrogen purge around normally sparking components (i.e., fan motor). As a result the limiting design requirements, it is difficult to show that it could be installed to support other operations on a continuous basis (e.g., to support saltwell pumping efforts which can take up to three years).

4.1.7.2 Salt-Well Pumping (SWP). The risk of flammable gas releases during SWP of tanks with large amounts of retained gas was judged to be sufficiently uncertain to warrant placing this operation on hold in certain tanks. An initial safety assessment was performed for SWP in Tank 241-A-101 and provides for ventilation system functional design criteria for a portable exhauster. The active ventilation system shall consist of at least a 200 cfm exhauster, its exhauster components meet Class-I, Division-1, Group B NFPA 497A requirements, and be capable of immediate pump deenergization upon exhauster power loss (WHC 1996m). SWP is currently prohibited from operation in SSTs that are identified as Facility Group 2 SSTs in the S/O (FDH 1996a, FDH 1996b). The SSTs are suspected of retaining large amounts of gas based on a gas release event evaluated result of greater than 50% of the LFL in the headspace (WHC 1996a).

4.1.7.3 Retrieval Activities. Tank waste retrieval from SSTs is divided into near term and medium term operations. Near-term operations include the removal of high-heat waste from the SST C-106 to DST AY-102 through sluicing operations. Project W-320, the Waste Retrieval Sluicing System, will provide its own ventilation system (which must be operational during sluicing operations) while the sluicing operations are performed. While the active ventilation system on C-106 (which is also connected to C-105) is maintained in an operational standby status as a backup for cooling, its main function will be to provide a high-flow exhaust system to support C-106 large riser opening maintenance activities (WHC 1996j).

The Initial Single-Shell Tank Retrieval Systems (ISSTRS) currently plan on starting retrieval of waste in the following tanks in the year 2003 with approximately one tank per year (in the respective order: 1) AX-103; 2) C-105; 3) C-103; and 4) A-105. It is the intent of the ISSTRS program to use the C-106 proof-of-operation and lessons learned to develop and provide ventilation systems that are sufficient to meet the ignition control set requirements.

4.2 Existing Condition

Active ventilation systems typically consist of ductwork connecting the tank, or tanks, to an exhauster system. The exhauster system normally consists of a moisture removal device, a heater, two HEPA filter banks in series, a fan, and a stack. The SSTs have breather filters that serve as inlet filters (WHC 1994b). It has been determined that all of the SST passive ventilation systems are adequate for steady state flammable gas conditions (WHC 1996a).

Through October 1991, tanks A-104 and A-105 were required to be actively ventilated to reduce waste temperature enough to maintain structural integrity. However, temperature trends have been analyzed and conclusions have been drawn that the tank temperatures have reached a steady-state below the established safety limit [150 °C (300 °F)], with slight oscillations described to exist because of varying seasonal temperatures. Therefore, the active ventilation system (exhauster 296-P-17) was recommended to be permanently removed. Temperature trends continue to be monitored, and all tanks within A-farm are passively ventilated (WHC 1994c).

Tanks C-105 and C-106 are linked together for ventilation. The current active ventilation system is being modified by Project W-320. This project must meet the current authorization basis requirements for SST ventilation systems.

All of the SSTs in 241-SX Tank Farm are connected to the active ventilation system except SX-113 and SX-115 for a total of 13 tanks connected to the system. Seven of the tanks in the farm, SX-101 through SX-106 and SX-109, SX-107, SX-112 and SX-114 have been identified with flammable gas concerns (WHC 1996h). Additionally, seven of the tanks, SX-107 through SX-112, and SX-114, have been identified to have high heat loads (WHC 1996i). The active ventilation system in the 241-SX farm has exceeded its expected service life with components by as little as 17 years, and as much as 27 years (WHC 1994b). As a note, several hardware deficiencies exist upon review of other requirements and have been identified as follows: 1) filter housings are non-testable; and 2) there are several maintenance problems associated with the system. Additionally, the system has not proven its efficiency in removing organic vapors, hydrogen gas releases, or removing heat (WHC 1996k).

The compliance determination and status summary matrix for SSTs ventilation systems are provided in Appendix A in tabular form and represents information gathered from numerous documents and interviews with Westinghouse Hanford Company personnel.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation completed, both active and passive ventilation systems are acceptable for continued safe operation. However, a risk assessment should be performed on the SX-farm active ventilation system in the near future to further evaluate safety concerns. Recommendations for system upgrades are provided below in section 5.4.

Of the 149 SSTs, 15 are identified as requiring active ventilation systems. They are physically configured as follows: 1) C-farm: 1 system with 1 fan (tanks C-105 -- C-106), and 2) 241-SX - Farm: 1 system with 2 fans (tanks SX-101 -- SX-112 and SX-114). The remaining 134 tanks are required to be passively ventilated. Depending on configuration, equipment modifications may be required to be reviewed by the Hanford Flammable Gas Advisory Board.

5.1 Ventilation Systems Meet Requirements

A total of 134 tanks have been identified to maintain their present status. Salt Well Pumping is not allowed in 44 of the SSTs (FDH 1996b). Continued management of these tanks using the current management philosophy will adequately meet the TWRS mission and protect the health and safety of workers and general public.

5.2 IS Criteria

All 15 of the actively ventilated tanks require upgrades to meet the IS criteria for automatic pressure monitoring by TMACS (only tank C-106 has pressure sensors hardwired to TMACS). Both actively ventilated systems (C-farm and SX-farm) require upgrades for the stack radiation monitoring to be connected to TMACS. The details of IS criteria are described in the *Controlled, Clean and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e).

5.3 Operability of the Ventilation Equipment

The ventilation equipment for the tanks in 241-SX-farm has been operating well beyond its useful life. Several problems have been identified in *Tank Farm Restoration and Safe Operations Initial Assessment Report HVAC Systems* as follows: 1) filter housings are non-testable; and 2) there are several maintenance problems associated with the system. Additionally, the system has not proven its efficiency in removing organic vapors, hydrogen gas releases, or removing heat (WHC 1996k).

Detailed results of evaluation for each SST are given in Appendix A under the "Comments" column and are summarized below.

5.4 Recommendations for Continued Safe Operation of SSTs

The following is a list of concise recommendations for continued safe operation of SSTs.

A. Continue to operate all passively ventilated tanks with maintenance schedules for safe operation. It is recommended that SSTs on the Flammable Gas or USQ Watch List be precisely monitored for gas release events and unusual events such as sudden increase of waste temperature.

B. Perform a risk assessment on the 241-SX-farm active ventilation system. (Note: A process test utilizing data quality objectives was recently proposed to quantify and document the current peak waste temperatures and hydrogen levels on the actively ventilated SSTs in the 241-SX-farm. Results from this test along with a risk assessment would provide the authorization basis for determining if the system requires upgrade/reinstallation or removal of system. However, this process test was not funded for this fiscal year.)

C. Based on the risk assessment performed on the SX-farm active ventilation system, either replace the hardware or turn the system off and make sure that each of the those tanks meet the requirements for passive ventilation. Appendix H provides preliminary cost estimates for replacement of the hardware.

D. When a decision is made to go forward with interim stabilization of the SX-farm and C-farm, pressure sensing instrumentation and radiation stack monitoring is required to be connected to TMACS in all of the 15 actively ventilated tanks (with the exception of tank C-106 which only requires TMACS connection of the radiation stack monitor).

E. Follow all requirements identified in the *West/East Tank Farms Standing Order documents* (FDH 1996a, FDH 1996b). Continue close watch for hydrogen and flammable gas releases. The performance of a ventilation system is now judged by it's efficiency to purge hydrogen and other flammable gases.

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APPENDIX A

COMPLIANCE DETERMINATION AND STATUS SUMMARY FOR SINGLE-SHELL TANKS

TABLE A-1. Compliance Determination and Status Summary for Single-Shell Tanks[1].

NOTE: The footnotes that define each column are located on page A-17 and A-18.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
A-101	Hydrogen/ Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
A-102	Non-Watch list	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
A-103	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
A-104	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N	4, 14	Y	Continue to maintain present status. Note: If this system is deemed to be active again then upgrades will be necessary.
A-105	Non-Watch list (Damaged Tank)	P	IS/IP	none	Y	3,Y	Y	N/A	N	4, 14	Y	Continue to maintain present status. Note: If this system is deemed to be active again then upgrades will be necessary.
A-106	Non-Watch list	P	IS/IP	None	Y	3,Y	Y	N/A	N	4, 14	Y	Continue to maintain present status. Note: If this system is deemed to be active again then upgrades will be necessary.
AX-101	Hydrogen	P	/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
AX-102	Organics	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
AX-103	Hydrogen	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
AX-104	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-101	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-102	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-103	Organics	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-104	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-105	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-106	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-107	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-108	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-109	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-110	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-111	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
B-112	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-201	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-202	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-203	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
B-204	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-101	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-102	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-103	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-104	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-105	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-106	Non-Watch list	P	IS/PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-107	Flam. Gas USQ	P	IS/PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-108	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization [4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent only)	OSD-13[6F]	OSD-30[6G]	
BX-109	Non-Watch list	P	IS/PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-110	Non-Watch list	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-111	Non-Watch list	P	IS/PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BX-112	Non-Watch list	P	IS/PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-101	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-102	Flam. Gas USQ	P	IS/PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-103	FeCN and Flam. Gas USQ	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-104	FeCN	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-105	FeCN and Flam. Gas USQ	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-106	FeCN and Flam. Gas USQ	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-107	FeCN	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-108	FeCN	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-109	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
BY-110	FeCN	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-111	FeCN	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
BY-112	FeCN	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-101	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-102	Organics	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-103	Organics	P	PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-104	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N	Y	Y	Continue to maintain present status.
C-105	Non-Watch list	A	IS/PI	N/A	Y	3,Y	Y	Y	N	Y	Y	Need to comply with IS ventilation criteria for monitoring temperature, pressure, and stack radiation levels. Note: Project W-320 is providing its own S/O compliant ventilation system.
C-106	High Heat	A	PI	N/A	Y	3,Y	Y	Y	N	Y	Y	Need to comply with IS ventilation criteria for monitoring stack radiation levels. Heat load for this tank is > 40,000 Btu/hr. Note: Project W-320 is providing its own S/O compliant ventilation system.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
C-107	Flam. Gas USQ	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-108	FeCN	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-109	FeCN	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-110	Non-Watch list	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-111	FeCN	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-112	FeCN	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-201	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-202	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-203	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
C-204	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-101	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-102	Hydrogen/ Organics	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-103	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization [4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
S-104	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-105	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-106	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-107	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-108	Non-Watch list	P	PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-109	Flam. Gas USQ	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-110	Non-Watch list	P	PI	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-111	Hydrogen/ Organics	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
S-112	Hydrogen	P	PI	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
SX-101	Hydrogen	A	PI	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
SX-102	Hydrogen	A	PI	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.
SX-103	Hydrogen/ Organics	A	PI	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.
SX-104	Hydrogen	A	PI	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.
SX-105	Hydrogen	A	PI	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.
SX-106	Hydrogen/ Organics	A	PI	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization [4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
SX-107	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-108	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-109	Hydrogen	A	IS/IP	N/A	3	2,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Tank SX-109 has Hydrogen potential because tanks SX-101 through SX-106 vent through tank SX-109. Need to comply with IS Ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization [4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
SX-110	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-111	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-112	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	Y	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-113	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	Y	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
SX-114	Non-Watch list	A	IS/IP	N/A	3	3,Y	Y	N/A	N	Y	Y	Risk assessment should be performed. Need to comply with IS ventilation criteria for monitoring pressure and stack radiation levels. Heat load for this tank is > 40,000 Btu/hr.
SX-115	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	Y	N/A	Y	Y	Continue to maintain present status.
T-101	Non-Watch list	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-102	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-103	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-104	Non-Watch list	P	PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-105	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-106	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-107	FeCN	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-108	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-109	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
T-110	Hydrogen	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-111	Organics	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-112	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-201	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-202	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-203	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
T-204	Flam. Gas USQ	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-101	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-102	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-103	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-104	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-105	Organics	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-106	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization [4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC [6C]	TSR[6D]	IS(6E) (for vent. only)	OSD-13[6F]	OSD-30[6G]	
TX-107	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-108	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-109	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-110	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-111	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-112	Flam. Gas USQ	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-113	Non-Watch list	P	IS/IP	G-1 Housing	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-114	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-115	Non-Watch list	P	IS/IP	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-116	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-117	Non-Watch list	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TX-118	Organics/FeCN	P	IS/IP	G-1 Housing	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TY-101	FeCN	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
TY-102	Non-Watch list	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TY-103	FeCN	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TY-104	Organics/FeCN	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TY-105	Non-Watch list	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
TY-106	Non-Watch list	P	IS/IP/IS	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-101	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-102	Non-Watch list	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-103	Hydrogen/ Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-104	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-105	Hydrogen/ Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-106	Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-107	Hydrogen/ Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-108	Hydrogen	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

Tank ID Number	Watch List[2] Status (Justification)	Type of[3] Vent System (Active or Passive)	Stabilization[4] Status	Vent[5] Filter Type	Requirements[6]							Comments
					IOSR[6A]	S/O[6B]	SSC[6C]	TSR[6D]	IS[6E] (for vent. only)	OSD-13[6F]	OSD-30[6G]	
U-109	Hydrogen	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-110	Non-Watch list	P	IS/PI	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-111	Organics	P	PI	Open Face	Y	2,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-112	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-201	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-202	Non-Watch list	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-203	Organics	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.
U-204	Organics	P	IS/IP	Open Face	Y	3,Y	Y	N/A	N/A	Y	Y	Continue to maintain present status.

FOOT NOTES

1. Data presented in this table have been compiled from several source documents that are identified in the notes below.

   - The shaded rows represent those SSTs that are on a Watch List.

2. The Watch List status for each tank is obtained from the document, *Operating Specifications for Watch List Tanks* (WHC 1996h).

   - Several tanks, which were classified as non watch-list tanks before, are reclassified as "Flam Gas USQ." Watch list controls are required for these tanks pending further direction from DOE. Among 24 SSTs classified as Flam. Gas USQ, three tanks (BY-103, -105, and-106) are also on the FeCN watch list.

   - A total of ten tanks are identified to generate heat in excess of 40,000 Btu/hr. SST C-106 is the only tank whose waste has a high enough heat load to continuously exceed the safety limit of 150 °C (300 °F) if not cooled (through addition of water [evaporative cooling] and through active ventilation [convective cooling]).

3. The type of ventilation system for each SST is identified in the report titled *Waste Tank Summary Report for Month Ending May 30, 1996,* (WHC 1996i). There are 15 SSTs that utilize active ventilation. The remaining 134 tanks are passively ventilated.

4. The stabilization status of each tank is listed in Table E-6 in *Waste Tank Summary Report for Month Ending May 30, 1996,* WHC-EP-0182-99, August 1996. The controlled, clean, and stable (CCS) functions have been accomplished for six tanks, TY-101 through -106.

   IS - Interim Stabilized
   PI - Partially Interim Isolated
   IP - Intrusion Prevention

   Note: Refer to Appendix C in the Waste Tank Summary Report of detail descriptions for these activities.

5. Breather filter types are taken from the report, *An Engineering Review of Tank Farm Ventilation System* (WHC 1994b).

6. Requirements for compliance were taken from several documents that were considered pertinent for evaluating the SST ventilation system. Based on the information available, a list of requirements was identified and is listed in Appendices B -- G. The letter "Y" indicates that the requirement is met, letter "N" indicates that the requirement is not met, and "N/A" indicates that this particular requirement is not applicable.

   6.A. The reference document for this column is, *Single-Shell Tanks Interim Operational Requirements* (WHC 1994a). The non-compliant requirements are identified by numerical numbers. Refer to corresponding number(s) in Appendix B for the description of requirement(s).

   6.B. The reference document for this column is *West/East Tank Farms Standing Orders* (FDH 1996a, FDH 1996b). The gas release events (GRE) were evaluated and underground the storage tanks were classified into three Facility Groups. All SSTs fit into Group 2 or 3. The first number in this

column indicates the group in which a particular tank is placed. Refer to corresponding number(s) in Appendix C for the description of requirement(s).

6.C. The reference document for this column is, *TWRS Safety Structures, Systems, and Components: Requirements and Characteristics* (WHC 1996d). Refer to corresponding number(s) in Appendix D for the description of requirement(s).

6.D. The reference document for this column is, *TWRS Technical Safety Requirements* (WHC 1996c). All actively ventilated systems meet the requirement. All passively ventilated systems are marked N/A. Refer to Appendix E for the description of requirements.

6.E. The reference document for this column is, *Controlled, Clean, and Stable Functions and Endpoint Criteria for Single-Shell Tank Farms*, (WHC 1996e). Refer to corresponding number(s) in Appendix F for the description of requirement(s).

6.F. The reference document for this column is, *Operating Specifications for Single-Shell Waste Storage Tanks* (WHC 1996g). The non-compliant requirements are identified by numerical numbers. Refer to corresponding number(s) in Appendix G for the description of requirement(s).

6.G. The reference document for this column is, *Operating Specifications for Watch List Tanks* (WHC1996h). Refer to corresponding number(s) in Appendix G for the description of requirement(s).

APPENDIX B

Functional Requirements from Single-Shell Tank Interim Operational Safety Requirements

This appendix lists the requirements from the *Single-Shell Tank Operational Safety Requirements* (WHC 1994a) which are applicable to SST ventilation systems. Additionally, a column has been provided to identify the implementing document that ensures the requirements are being met and/or the actual equipment configuration status of the tanks to ensure the requirements are being met.

Table B-1. OSR-005 Requirements Applicable to SST Ventilation Systems

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
1	Single-Shell Tank pressure monitoring system shall be OPERABLE on actively ventilated tanks with a maximum pressure of 0 inches water gauge. The minimum pressure in each tank vapor space relative to atmosphere shall be maintained. a. For tanks with ≥ 10 inches WASTE maintain pressure ≥ - 9.5 inches water gauge. b. For tanks with < 10 but ≥ 4.5 inches WASTE maintain pressure ≥ the negative of (the WASTE height minus 0.5) in inches water gauge. c. For tanks with < 4.5 inches WASTE maintain pressure ≥ 4 inches water gauge	OSR-005 LCO 3.3.1	**TO-060-015** **TO-060-050** **TO-400-120** **TF-OR-EF-C-D** **TF-OR-WST-02-D**
2	Seal loops shall be OPERABLE on passively ventilated tanks.	OSR-005 LCO 3.3.1	**TO-060-015** **Daily/Weekly round sheets**
3	Single-Shell Tank active ventilation exhaust stack radiation monitoring system shall be OPERABLE	OSR-005 LCO 3.4.1	Active ventilation systems are equipped with continuous air monitors (CAM) and record samplers.

APPENDIX C

Functional Requirements from West/East Tank Farms Standing Orders

The purpose of this S/O is to specify the allowed safe conditions and control requirements that address the flammable gas hazards. Section 6 of this document identifies the required ventilation controls for SSTs. They are provided here for completeness.

The current ventilation controls as specified in the currently implemented Authorization Basis will be the compensatory actions until S/O Ventilation requirements are implemented.

In addition to the above the following controls will apply.

(1) The specification limits of OSD-T-151-00013, section 13.2.2.D.2, for passive breathing pathways. (See Appendix G for details on compliance.)

(2) Verify passive breather filter isolation valve is open, every 10 days, or establish an alternate ventilation path.

Additionally, Ignition Control (IC) Set requirements for manned and unmanned operations (also provided below) ensure that all of the safety limits are met. The IC Sets are provided below for completeness.

Single-shell tanks have been evaluated for the potential types of Gas Release Events (GRE) and categorized into Facility Groups 2 and 3 so that a matrix could be developed that implemented IC sets. A detailed identification of SST and its facility group is provided in Appendix A.

C-1.0 Ignition Source Control Set 1

This set is used for all equipment that is installed or used during work activities for that portion of the equipment that can contact the undiluted gases that are retained within the waste or are present in the vapor space of waste intruding equipment. The basis is that flammable conditions may be present often or always in these locations; and therefore, the highest level of control, consistent with NFPA 70 (NFPA 1993a) Class I, Division 1 is appropriate.

C-1.1 Mechanical tooling, equipment and materials (including lubricants, adhesives, gaskets, corrosion inhibitors, epoxies, etc.) shall be constructed of spark-resistant material, or shall be rendered incapable of sparking, or shall have been analyzed and evaluated to not be capable of sparking under the applied conditions (WHC 1990). Material compatibility shall be evaluated for thermite reaction potential (WHC 1996k).

C-1.2 Electrostatic ignition sources shall be controlled by providing bonding or grounding according to NFPA 77 (1993).

C-1.3 Exposed polymer materials shall be rendered incapable of electrostatic charge or discharge potential either by design or through acceptable workaround practices providing equivalent safety (NFPA 77 1993).

C-1.4 The surface temperatures of heat-generating devices shall not exceed 80% of the autoignition temperature of the flammable gas (for this Standing Order, this is defined as 80% of 520 °C which equals 416 °C [780 °F]). If the device can contact the waste and cause ignition by triggering exothermic reactions in the waste (i.e., organic-nitrate reactions) the surface temperature is limited to 160 °C (320 °F). Internal temperatures of heat generating devices may exceed these temperatures if isolated from the gas environment, or if the design of the device enclosure meets requirements for explosion-proof housings.

C-1.5 Electrical equipment shall be designed to meet NFPA 70 (1996). Class I, Division 1, Group B criteria or equivalent safety. As a minimum, this shall be interpreted to mean that no single-point failure of energized equipment can result in an arc or spark, or gas burn propagation to the environment external to the source enclosure. In the case of waste-submerged equipment containing potential ignition sources, demonstration by design that the equipment is non-sparking under normal operation and is designed to be isolated from the waste environment is an acceptable alternative.

C-1.6 Shutdown of purged and pressurized electrical equipment and purged and pressurized heat-generating equipment, upon loss of protective gas pressure or flow, shall be automatic by design as defined by NFPA 496 Type X pressurization.

C-1.7 Interlocked start-up of purged and pressurized electrical or purged and pressurized heat-generating equipment shall only be allowed upon system sensing of pre-set safety limits. If pressurized enclosures are used to isolate energized components, a minimum of four (4) enclosure volumes shall be purged through the enclosure for energized components, and/or ten (10) volumes shall be purged for enclosed motors prior to controlled start-up of the system components.

C-2.0 This set is applied to vapor space locations (ex-tank, intrusive and dome-intrusive) when a GRE is postulated to create flammable conditions. Set 2 is similar to Set 1 except that requirements (6) and (7) are modified to allow the use of more readily available equipment. The basis is that the flammable conditions are unlikely and would persist for relatively short periods of time.

C-2.1 Ignition Source Control Set # 1 items 1 through 4.

C-2.2 Electrical equipment shall be designed to meet NFPA 70 (1996), Class 1, Division 2, Group B criteria or equivalent safety. As a minimum, this shall be interpreted to mean the equipment is non-sparking under normal operation or, if normally sparking, the sparking component(s) shall be continuously isolated (purged and pressurized) from the potentially flammable gas environment, or the design of the device enclosure shall be of sufficient strength (explosion-proof) to prevent propagation of a gas burn to the environment external to the enclosure.

C-2.3 Either automatic shutdown or alarming with manual shutdown will be required upon loss of protective gas pressure or flow as defined by NFPA 496 (1993) Type Z pressurization. In ex-tank area applications, electrical equipment that does not meet Class I, Division 2, Group B may be used, if it is automatically shutdown by combustible gas detection systems.

C-2.4 Automatic or manual start-up of purged and pressurized electrical or purged and pressurized heat-generating equipment shall only be allowed upon system sensing of pre-set safety limits . If pressurized enclosures are utilized to isolate energized components, a minimum of four (4) enclosure volumes shall be purged through the enclosure for energized components, or ten (10) volumes shall be purged for enclosed motors prior to controlled start-up of the system components. When combustible gas detection shut down systems are employed, start-up of equipment shall only be allowed once measured acceptable flammable gas levels are indicated.

The specific application of the Standing Order Ignition Source Controls and the determination of equivalencies can vary with different activities and facilities and equipment due to uniqueness in configurations, materials and specific spark source hazards present. Specific application of safety measures occurs at the operating procedure and work package level. The specific application is reviewed for compliance with the requirements and intent of the Standing Order controls. A Flammable Gas Equipment Advisory Board has been formed to determine when the specific

application meets or provides equivalent safety, when appropriate. It is important to note that Ignition Source Control Sets 1 and 2 were developed to guide engineers to safe design of new equipment. For existing installed equipment and current processes, the flexibility for evaluating equivalent safety is necessary in order to continue using this equipment and those processes. This may require modifications in some cases, but not in others.

APPENDIX D

Functional Requirements from Tank Waste Remediation System Safety Structures, Systems, and Components: Requirements and Characteristics

The Tank Waste Remediation System Basis for Interim Operation (WHC 1996b) (BIO) establishes an improved authorization basis for TWRS facilities and operations required for the storage management of high-level waste (current and future tank waste). The *Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b) provides the basis for the conclusion that authorized TWRS facility operations can be conducted safely until approval of the TWRS FSAR. Chapter 5 of *The Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b), "Safety Analyses", documents the selection of controls for 23 accident scenarios, and supports the selection with confirming analyses. The selected controls will maintain the facility within a safe operating envelope and protect the facility worker, the onsite worker, the offsite public, and the environment. The safety analyses process of identifying safety systems, structures, and components (SSCs) involved a graded approach for applying design and quality requirements to engineered features that maintain or perform safety functions. Selection of controls was done by an experienced team which included operations, hazard analysis, accident analysis, management, engineering, and appropriate subject matter specialists. The *Tank Waste Remediation System Safety Structures, Systems, and Components* (WHC 1996d) supplements the Chapter 5 controls selection by providing a description of the attributes of the specific SSCs required to provide the necessary functions, and thereby supplies the information needed for derivation of the Technical Safety Requirements (TSRs) for the *The Tank Waste Remediation System Basis for Interim Operation* (WHC 1996b).

SST Ventilation

Safety Classification. The SST ventilation systems are identified as safety -class SSCs for the Flammable Gas Deflagrations accident.

Safety Function(s). Maintain flammable gas concentrations in tank dome spaces, due to steady state releases, below 25% of the LFL.

System Description. Active ventilation systems remove flammable gases from the following SSTs.

- All tanks in Single-Shell Tank Farm 241-SX (except for 241-SX-113 and -115)
- SSTs 241-C-105 and -106

The remaining SSTs are equipped with passive ventilation systems. Active and passive systems are described below.

Active Ventilation. The systems draw outside air into the tanks through HEPA-filtered inlet stations. The air mixes with and displaces the flammable gases produced by the waste. The air/gas mixture is then removed from the tanks, filtered to remove radioactive particulates, and exhausted to the environment.

Active ventilation systems are vulnerable to drive train malfunctions, loss of electrical power, and control system trips due to malfunctioning process monitors. Mean time between failures (MTBF) has typically been very short by common industrial performance standards and has been measured in weeks. Equipment upgrades and improved maintenance procedures have proven that MTBF can be increased to a year or more.

Passive Ventilation. A passive ventilation consists of a filter housing, a HEPA filter, and a shutoff valve. The filter housing is fabricated with a riser adapter which allows the housing to be bolted directly to a 4-inch tank riser. The riser adapter contains a shutoff valve which is open during normal operation of the breather filter assembly . The shutoff valve is closed to isolate the HEPA filter from the tank so that aerosol testing of the filter can be completed. The valve is also used to isolate a filter that has failed the aerosol test, until the filter is replaced. The HEPA filter prevents the release of airborne radioactive particulates to the environment.

Passive ventilation systems allow flammable gases to be exhausted from the SSTs whenever the tank vapor space pressure exceeds atmospheric pressure. Conversely, the system allows air into the tank when atmospheric pressure exceeds the vapor space pressure. This influx of additional air dilutes the concentration of flammable gas in the vapor space.

Passive ventilation systems are vulnerable to damage by out-of-control vehicles, rainwater intrusion (in some tanks) and breather filters plugged by airborne dust.

Functional Requirements

Active Ventilation. Single-shell tank active ventilation systems shall maintain a vacuum in the tank vapor space, relative to atmospheric pressure.

Passive Ventilation. A HEPA filtered flow path shall be provided to allow the vapor space pressure to be in equilibrium with the atmospheric pressure.

System Evaluation

Active Ventilation. Proper operation of the active ventilation systems shall be verified daily.

Passive Ventilation. The breather filter isolation valve must be checked weekly to ensure that flow path is unobstructed.

Supporting SSCs

Active Ventilation. Electrical power.

Passive Ventilation. None.

APPENDIX E

Functional Requirements from Tank Waste Remediation System Technical Safety Requirements

This appendix lists the requirements from the *Tank Waste Remediation System Technical Safety Requirements* (WHC 1996c) which are applicable to SST ventilation systems. Additionally, Table E-1 identifies the implementing document that ensures the requirements are being met and/or the actual equipment configuration status of the tanks to ensure the requirements are being met.

Table E-1. Technical Safety Requirements Applicable to SST Ventilation Systems

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
1	The Ventilation Stack CAM Interlock system shall be operable in SSTs with active ventilation (C and SX tank farms).	TSR-006 LCO 3.1.4	**TO-060-050** [1] 105/106-C Exhauster; **TO-400-120** [2] 241-SX Exhauster; and **6-TF-077** Stack Sampling and Monitoring System Maintenance. Note: the above procedures may require some changes to comply with TSR requirements.
2	An active ventilation system shall be operable in SSTs with active ventilation systems. (C-105, C-106, SX-101, SX-102, SX-103, SX-104, SX-105, SX-106, SX-107, SX-108, SX-109, SX-110, SX-111, SX-112, and SX-114).	TSR-006 LCO 3.2.2	**TO-060-050** 105/106-C Exhauster; **TO-400-120** SX Exhauster; **TF-OR-EF-C-D** C-Farm Daily Rounds; **TF-OR-EF-W ST-01-D** SX Daily Rounds; **6-TF-156** HEPA Filter Aerosol Test ; **6-TF-155** Stack Air Flow Test; and **6-TF-237** Fan Inspection. Note: The above procedures may require some changes to comply with TSR requirements.
3	The HEPA breather filter isolation valve shall be open and no blank installed in passively ventilated SSTs.	TSR-006 LCO 3.2.3	**TF-OR-EF-AAX-W** A/AX Weekly Rounds; **TF-OR-EF-C-W** C Farm Weekly Rounds; **TF-OR-WST-01-W** S, SX, SY Weekly Rounds; **TF-OR-WST-02-W** 242T, TX,TY and U Farm Weekly Rounds; **TF-OR-WF-B-W** B, BX, BY Weekly Rounds ; **TO-060-015** Monitor/Change Out Storage Tank Breather Filters; and **6-TF-157** Single-Shell Tank HEPA Filter Aerosol Test. Note: the above procedures may require some changes to comply with TSR requirements.

Note
1. Procedures beginning with "TO" are classified as Tank Farms Plant Operating Procedures.
2. Procedures with "TF" in the title are classified as Tank Farms Rounds or Maintenance Procedures.

APPENDIX F

Interim Stabilization Functional Requirements

This appendix provides a table identifying the actively ventilated SSTs and their status/ configuration for meeting the IS ventilation requirements as called out in the, *Controlled, Clean, and Stable Design Requirements Document for Single-Shell Tanks* (WHC 1996e), Sections 3.2.1.1.5; 3.2.1.1.5.1 - 3.2.1.1.5.2). Interim Stabilization requires each actively ventilated tank to be monitored remotely (e.g., connected to TMACS). The instrumentation components associated with the ventilation systems required to be connected to TMACS are 1) pressure monitoring and 2) exhaust stack radiation monitoring (CAM). Requirements for passively ventilated IS tanks are met through standard tank farms "rounds sheets" (verification checks at defined intervals of time.)

Table F-1. Actively Ventilated Tanks Interim Stabilization Compliance

No.	Tank No.	Pressure Monitoring	Exhaust Stack Radiation Monitoring	Meets IS Criteria
1	C-105	No	No	No
2	C-106	Yes	No	No
3	SX-101	No	No	No
4	SX-102	No	No	No
5	SX-103	No	No	No
6	SX-104	No	No	No
7	SX-105	No	No	No
8	SX-106	No	No	No
9	SX-107	No	No	No
10	SX-108	No	No	No
11	SX-109	No	No	No
12	SX-110	No	No	No
13	SX-111	No	No	No
14	SX-112	No	No	No
15	SX-114	No	No	No

Reference: Waste Tank Summary Report for Month Ending May 31, 1996 (WHC 1996i)

APPENDIX G

Functional Guidelines from the Tank Waste Remediation System Operational Specifications Documents

This appendix lists functional requirements from the *Operating Specifications Document for Single-Shell Waste Storage Tanks* (OSD-T-151-00013) and the *Operating Specifications for Watch List Tanks* (OSD-T-151-00030) which are applicable to SST ventilation systems. Additionally, a column has been provided to identify the implementing document that ensures the requirements are being met and/or the actual equipment configuration status of the tanks to ensure the requirements are being met.

Table G-1. OSD-13-T-0013 and OSD-30-T-151-0030 Functional Requirements Applicable to SST Ventilation Systems

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
1	Vapor space pressure in SSTs shall be minimum of 1 in. wg.- Waste height (in. wg) not to exceed -9 in. wg.	OSD-13 13.2.1.F	**TO-060-015 TO-060-050 TO-400-120**
2	A pressure gauge shall be installed at the tank side inlet of each exhauster (an acceptable alternative location is on a tank riser). Pressure is to be recorded at least every 24 hours on actively ventilated tanks.	OSD-13 13.2.1.F	**TF-OR-EF-C-D TF-OR-WST-02-D WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Tables 7-18 and 7-26.
3	A seal loop, which evacuates at 4 $\pm$1 in. wg, shall be installed on each passively ventilated tank. The seal fluid shall be nonvolatile, with a specific gravity as close to 1.0 as practical. The liquid level shall be maintained at 4 $\pm$1 inches, and the seal loop status recorded. Loop fluid levels on passively ventilated tanks shall be checked at least every 10 days and refilled if necessary.	OSD-13 13.2.1.F	**TO-060-015 Daily/weekly Round sheets**
4	Active ventilation shall be installed for cooling any SST which: 1) is expected to reach a peak high temperature which exceeds the maximum operating specification (see 13.2.1.E or 2) contains waste projected to boil.	OSD-13 13.2.1.G	Active ventilation was installed on 16 SSTs which showed temperature higher than 147 °C (300 °F). Tank Farm ' A' exhauster was shutdown in October 1991 and SX-farm ventilation system has exceeded its design life.

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
5	The annual average concentration of radionuclides released from a SST to the environment, in airborne effluents shall not exceed the derived concentration guides specified in Appendix C, WHC-CM-7-5.	OSD-13 13.2.2.B	Active ventilation systems are equipped with CAMs and record samplers. Continuous air monitors are interlocked to shutdown the ventilation fan when radionuclides exceed the high level set point. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Table 7-2 lists the CAM Alarm set points. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Table 7-1 lists the emission limits (Alpha and Beta) for various exhausters.
6	The two week average concentration of radionuclides released from a SST to the environment, in airborne effluents, shall not exceed four times the derived concentration guides specified in Appendix C, WHC-CM-7-5.	OSD-13 13.2.2.B	Active ventilation systems are equipped with CAMs and record samplers. Continuous air monitors are interlocked to shutdown the ventilation fan when radionuclides exceed the high level set point. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility) Table 7-2 lists the CAM Alarm set points. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Table 7-1 lists the emission limits (Alpha and Beta) for various exhausters.

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
7	The maximum instantaneous concentration of radionuclides released to the environment in airborne effluents shall not exceed 5000 times the derived concentration guides specified in Appendix C, WHC-CM-7-5.	OSD-13 13.2.2.B	Active ventilation systems are equipped with CAMs and record samplers. Continuous air monitors are interlocked to shutdown the ventilation fan when radionuclides exceed the high level set point. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Table 7-2 lists the CAM Alarm set points. **WHC-EP-0479-1** Facility Effluent Monitoring Plan for Tank Farm Facility Table 7-1 lists the emission limits (Alpha and Beta) for various exhausters.
8	All tank risers and pits except the exhauster connection shall be sealed prior to any planned shutdown	OSD-13 13.2.2.C	Work instructions in the work package will address these requirements.
9	All tanks on active ventilators shall have two stages of High Efficiency Particulate Air (HEPA) filtration in the outlet stream. Air inlets for active ventilation systems shall be HEPA filtered.	OSD-13 13.2.2.D	**SAR-006 Section 5.2.6.1**
10	All SSTs shall be passively ventilated using HEPA breather filters even if active ventilation is temporarily installed.	OSD-13 13.2.2.D	**SAR-006, Section 5.2.6.2**
11	Filter Differential Pressure in first filter in a series shall have maximum 5.9 in. wg and minimum 0.05 in. wg	OSD-13 13.2.2.E	**TO-060-015 Daily/Weekly Round Sheets**
12	Filter Differential Pressure in other filter in a series shall have maximum 4.0 in. wg and minimum 0.05 in. wg	OSD-13 13.2.2.E	**TO-060-015 Daily/Weekly Round Sheets**
13	Filter Differential Pressure in total series of filters shall have maximum 5.9 in. wg and minimum 0.05 in. wg	OSD-13 13.2.2.E	**TO-060-015 Daily/Weekly Round Sheets**

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
14	HEPA Filter Temperature shall be ≤ 200 °F	OSD-13 13.2.2.F	**TO-060-050 TO-400-120**
15	HEPA Filter shall have minimum Efficiency of 99.95% for 0.3 um particles.	OSD-13 13.2.2.G	**6-TF-156 6-TF-157**
16	Single-shell tanks having Heat Generation Rate greater than 40,000 BTU/hr shall be designated as High Heat Tanks requiring temperature monitoring and/or active cooling to maintain acceptable temperatures.	OSD-13 13.2.6.B	Table A-3 of Waste Tank summary report for month ending May 31, 1996.
17	Sample tank breather filter outlet before breaking containment per Flammable Control Limits	OSD-13 13.4.1.1.B 13.4.1.2.B	Job Hazard Analysis before any work starts, will determine the need for sampling. Vapor spaces will be sampled per **WHC-SD-WM-HSP-002.**
18	For Tank Intrusive or Non-Tank Intrusive work in Tanks with passive ventilation systems or active ventilation system not in operation Spark resistant tools required for all openings >1 inch inner diameter until monitoring shows <25% of the LFL inside the work space.	OSD-13 13.4.1.1.B 13.4.1.2.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.
19	For Tank Intrusive or Non-Tank Intrusive work in Tanks with passive ventilation systems or active ventilation system not in operation: Electrical bonding per NFPA 77 of flange, cap, etc. to be removed is required for all openings >1 inch inner diameter until monitoring shows <25% of the LFL inside the work space.	OSD-13 13.4.1.1.B 13.4.1.2.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.
20	A vapor sample shall be taken at a nominal three feet inside the opening prior to start of work or as close to that depth as practical.	OSD-13 13.4.1.1.B	The J-4A instructions in the work package will address these restrictions.
21	For Non-Tank Intrusive work in Tanks with active ventilation system; Spark resistant tools required for all openings >1 inch inner diameter until vapor sampling demonstrates the flammable gas concentration is <25% of the LFL inside the work space.	OSD-13 13.4.2.1.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.

No.	Requirement	Reference	Implementing Doc/ Status or Configuration
22	For Non-Tank Intrusive work in Tanks with active ventilation system; Electrical bonding per NFPA 77 of flange, cap, etc. to be removed is required for all openings >1 inch inner diameter until vapor sampling demonstrates the flammable gas concentration is <25% of the LFL inside the work space.	OSD-13 13.4.2.1.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.
23	For Tank Intrusive work in Tanks with active ventilation system; Spark resistant tools required until vapor sampling demonstrates the flammable gas concentration is <25% of the LFL inside the work space.	OSD-13 13.4.2.2.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.
24	For Tank Intrusive work in Tanks with active ventilation system; Electrical bonding per NFPA 77 (NFPA 1993b) of flange, cap, etc. to be removed is required until vapor sampling demonstrates the flammable gas concentration is <25% of the LFL inside the work space.	OSD-13 13.4.2.2.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained using portable Combustible Gas Monitor.
25	When working in primary ventilation space (including dome space) or associated exhaust ventilation system of a Hydrogen/Flammable Gas and organic tank, use spark resistant tools and flammable gas concentrations shall be <25% of the LFL.	OSD-30 30.2.A.1.A, 30.2.C.1.B	The J-4A instructions in the work package will address these restrictions. The % LFL will be obtained/ monitored using portable Combustible Gas Monitor or SHMS.

APPENDIX H

PRELIMINARY COST ESTIMATES

Although this needs analysis report does not recommend any major ventilation system upgrades to maintain safe operation, it has identified possibilities for upgrades.

Preliminary Rough Order of Magnitude (ROM) cost estimates based on knowledge and experience of recommended system upgrades are required to complete the deliverable.

Several SSTs in the 241-SX-farm are on the watch list for Hydrogen/Flammable Gas, Organic and High Heat categories. Many studies have been conducted for evaluation of the ventilation system of 241-SX-farm. All the studies have concluded that the present ventilation system has exceeded its design life. All these studies have recommended that present ventilation system is not adequate and should be upgraded. The existing system should at least undergo a risk assessment to identify a basis for upgrading the system or for recommending the system be removed from active ventilation requirements and upgraded as necessary as a passive ventilation system.

The following tables list the ROM estimates for recommended upgrades for 241-SX-farm Ventilation System and need to be verified/updated when this project gets validated and complete scope of work is defined. Table H-1 estimates the cost of actual equipment, and table H-2 incorporates the cost of actual equipment with additional ROM estimates for complete system redesign, construction, and implementation of a new system. It is practical for the near future to first determine the need for an active ventilation system, and then proceed with component upgrades as necessary.

Table H-1. Estimated Equipment Cost for 241-SX Tank Farm Ventilation System Upgrades

Equipment Needed *	Estimated Cost (Dollars)
Moisture Eliminator	10K
Pre-filter	10K
HEPA Filter (2 stage)	30K
Fan	20K
Stack Monitoring	20K
Stack/ Ductwork	10K
Instrument & Controls	10K
Miscellaneous Equipment	40K
Total	150K

* Reference: Initial Assessment Report HVAC Systems (WHC 1996k).

Table H-2. Estimated Cost of 241-SX Tank Farm Ventilation Redesign, Construction, and Implementation.

Cost Category	Estimated Cost (Dollars)
Design/Engineering	200K
Material (from Table 6.1)	150K
Installation	400K
Testing	150K
Operations	200K
Old Equipment Removal, Decon and Waste Disposal	250K
Management and Overheads	100K
Contingency Plan	200K
Total	1,450K